View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Update Publishing (E-Journals)

Journal of Experimental Sciences Vol. 2, Issue 2, Pages 61-64 [2011]

JES Applied Sciences

Regular Article

Characterization of sludge drawn from sewage treatment plants based on tertiary treatment process at Dal lake, Srinagar, J & K, India

Bilal Ahmad Mir[1], Amit Pal[1*] and Sabah-ul-Solim[2]

[1]Institute of Environment & Development Studies, Bundelkhand University, JHANSI – 284 128, India; [2]Research & Monitoring Division, J & K Lakes and Waterways Development Authority, Srinagar, J & K, India

ABSTRACT: The aim of this work was to determine characteristics of the sewage sludge drawn from sewage treatment plants Laam, Habbak and Hazaratbal located at the bank of world famous Dal Lake, Srinagar. Analysis of the sludge showed that the major matrix elements were organic carbon, available nitrogen with significant percentage of available micro elements (Zn, Cu, Mn and Fe) although available phosphorous was also present in substantial amounts. The results showed increase in percentage of micro and macro nutrients in the sewage sludge during peak winter due to harsh climate prevailing in the valley which decreases the efficiency of secondary treatment of moving bed bioreactor sewage treatment plants. Moreover the sewage treatment plant of Laam shows increase in efficiency due to the diluted and low inflow of sewage coming to the sewage treatment plant. The Hazaratbal sewage treatment plant shows higher micro and macro nutrients due to the large catchments area which leads to the concentrated sewage inflow to the sewage treatment plant. Results showed that the organic carbon was found in significant percentage to be used for improving the soil physical characteristics. Among the DTPA extractable micro nutrients, Fe was present in dominant concentration although the Zn, Cu and Mn were present in sufficient quantity.

Key words: Dal Lake, micro and macro nutrients, sewage sludge, treatment plant

Introduction

Disposal of sewage sludge produced from sewage treatment plants is always a major environmental problem for many municipalities in world. The major concern is the enriched heavy metal and pathogens in sludge which may represent a potential health hazard to humans if they are not handled properly. Land application is an alternative which provide a means to dispose of the solid waste and at the same time to reutilize the nutrient value in sewage sludge.

Sewage sludge has been utilized for agriculture and horticulture for many years and represents a good source of nutrients for plant growth and a soil conditioner to improve soil physical properties (Jacob 1981; Matthews 1984; Bowen et al. 1992).

However it may also contain a range of potentially toxic metals, such as Cd, Cr, Pb, etc and high soluble salt contents (Chaney 1983). These may exist in excessive amounts, causing damage to plants and affecting human health upon consumption of plant grown on metal enriched sludge.

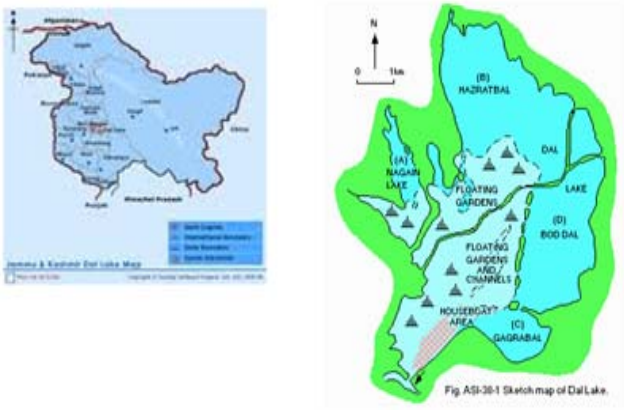
The concentration of plant nutrients in sewage sludge vary with the sewage treatment method, seasonal factor etc. Dewatered dried sludge are generally applied to agricultural land by surface spreading, while liquid sludge may be injected into the soil, spread over the soil surface. Kashmir is unique in India in having numerous lakes. Among the lakes in valley, Dal Lake has been prime subject of the locals as well as foreigners. The Dal Lake has been centre of the Kashmiri civilization and is among the most beautiful national heritages. Expansion of human settlements in catchments area of Dal Lake has disturbed its ecology. Heavy loads of nutrients in the form of domestic effluents, residual fertilizers, insecticides etc. drain into the lake without any check. The contamination of lake is predominantly organic in nature resulting in rapid degradation of organic matter affecting the Dal Lake.

In order to control the sewage pollution which is responsible for deteriorating the quality of water, the department of lakes and water ways development authority (LWDA) has constructed three moving bed bio reactor sewage treatment plants around the Dal Lake. The sludge drawn from these sewage treatment plants is so for as dumped near the lake. This study has significant, which would evaluate its nutrient value and other parameters for its safe economic use and disposal. Therefore this study was under taken to characterize the sludge drawn from these sewage treatment plants.

Material and Methods

The present study was carried out at famous Dal Lake of capital city of Jammu and Kashmir state of India (Figure – 1). The Dal Lake which has the length of 8 Km long and a width of 4 Km, spreads over a total of 26 Sq. Km. The fascinating Dal Lake is divided into two smaller ones the Lokut (small) and Bod (big) Dal. The south western part of the lake has a maximum depth of approximately 12 M. the Dal Lake gets some of its water from spring but is also supplemented by water from the mountain lake, Mar Sar. In the western part of the Lake one can glimpse a few islands, some bigger, some smaller. Its shores are very fertile and surrounded by willows. Potato, tomato, pumpkin, cucumber, radish and lots of other vegetables are grown here cultivation of the floating gardens which also lie in this part of the lake is another interesting feature. These gardens consist of reed rafts of different lengths and a width of approximately one and a half by three meters and are covered by 1020 CM thick layer of earth and mud. Vegetables and melons are grown on these artificial floating islands.

Fig. 1 : Study area



Sewage sludge was collected from sewage treatment plant Laam, Habbak and Hazratbal every fortnightly for period of six months from January to June which were further divided into winter and summer seasons.

The pH and electric conductivity (fresh weight basis) were measured in 1 : 2 extract using Systronic grip pH meter and direct reading conductivity meter. For organic carbon content of sludge (dry weight basis) Walkely and Black (1934) method was used. Available nitrogen of sludge (dry weight basis) was calculated using method of Subbiah and Asija (1956). Estimation of available phosphorous was determined using Olsen's method (1956).

The DTPA – extractable available micro nutrients as Iron, Zinc, Manganese and Copper were determined by method outlined by the

** Corresponding Author, Email: apu13@rediffmail.com*

ISSN: 2218-1768

Lindsay and Norwell (1978) and Assayed with Atomic Absorption Spectrophotometer.

Results and Discussions

Characterization of sludge provides useful information for its economic utilization and its possible environmental problem. In the present study the pH value ranges from 7.17 to 7.52. The pH values indicate that the sludge has slightly alkaline nature which would be useful for reclamation of acidic soils.

Electric conductivity of the sludge was lowest at 4.37 ms/cm in winter season from sludge of sewage treatment plant Hazratbal (Table – 3). The highest electric conductivity value of 4.96 ms/cm was recorded in summer season from sludge of sewage treatment plant Laam due to rainfall which leads to increase in inflow of STP (Table – 1).

The amount of organic carbon varied from 26.90% to 36.80% .The maximum value of 36.80% was found in sewage sludge of STP Hazratbal due to the large catchments area and more concentrated inflow coming to plant. However the organic carbon content was found in significant percentage for improving the soil physical properties and productivity of crops, wheat, maize, cotton (Jawakar et al. 1991; Zoubi et al. 2008).

Table 1 : Analytical determination of sludge drawn from sewage treatment plant Laam

Seasons	pH	Organic carbon (%)	E.C. ms/cm	Available nitrogen mg/kg	Available phosphorus mg/kg	Available zinc mg/kg	Available Copper mg/kg	Available manganese mg/kg	Available Iron mg/kg
Winter	7.17 ±0.87	29.81 ±6.4	4.43 ±0.15	43.71 ±2.79	8.18 ±0.88	539.50 ±5.87	507.33 ±5.70	578.16 ±1.11	10971.66 ±831.00
Summer	7.22 ±1.17	28.00 ±3.2	4.96 ±0.48	46.21 ±3.09	6.95 ±2.10	530.08 ±7.45	519.03 ±4.43	578.20 ±1.70	10438.66 ±922.71

pH & E.C. was calculated on (fresh weight basis), values are mean ±2 samples in each months from January to June.

Table 2 : Analytical determination of sludge drawn from sewage treatment plant Habbak

Seasons	pH	E.C. ms/cm	Organic carbon (%)	Available nitrogen mg/kg	Available phosphorus mg/kg	Available Iron mg/kg	Available Copper mg/kg	Available manganese mg/kg	Available Zinc mg/kg
Winter	7.52 ±0.14	4.56 ±0.54	34.90 ±9.71	44.93 ±1.62	8.13 ±3.00	11107.80 ±618.07	514.50 ±4.22	584.50 ±4.60	560.23 ±5.10
Summer	7.41 ±0.05	4.61 ±0.09	26.90 ±6.98	51.14 ±21.4	7.86 ±1.42	10583.46 ±639.07	508.18 ±5.84	578.18 ±1.89	559.70 ±17.60

pH and E.C. was calculated on (fresh weight basis), values are mean ±2 samples in each months from January to June.

Available nitrogen was found range from 43.71 mg/kg to 51.14 mg/kg. The minimum was found in sludge of STP Laam and highest value of 51.14mg/kg was recorded in sludge of STP Habbak (Table – 2). On calculating over all value it was found that the sludge has significant percentage of available nitrogen to be used for raising crop productivity especially of rice, wheat, maize (Seleiman et al. 2010; Akram et al. 2006; Zoubi et al. 2008). Further its application in winter season shows better results than using the chemical fertilizers (Hormamn et al. 1995). In the present survey the available phosphorus ranges from 6.95mg/kg to 9.11mg/kg. Moreover the available phosphorus values were found in higher quantity in winter than summer because of the harsh climate which leads to reduce efficiency of secondary treatment of moving bed-bioreactor sewage treatment plants

Table 3 : Analytical determination of sludge drawn from sewage treatment plant Hazratbal

Seasons	pH	Organic carbon (%)	E.C. ms/cm	Available nitrogen mg/kg	Available phosphorus mg/kg	Available Iron mg/kg	Available Copper mg/kg	Available manganese mg/kg	Available Zinc mg/kg
Winter	7.17 ±0.03	36.80 ±1.36	4.37 ±0.23	50.43 ±2.42	9.11 ±0.24	11546.86 ±913.35	526.16 ±9.44	605.33 ±3.01	573.83 ±12.46
Summer	7.18 ±6.20	30.17 ±7.85	4.65 ±0.40	48.81 ±1.83	8.36 ±1.52	11485.43 ±620.80	530.10 ±1.00	603.90 ±3.30	566.00 ±3.02

pH and E.C. was calculated on (fresh weight basis), values are mean ±2 samples in each months from January to June.

Moreover on calculating the over all availability of phosphorous it was found that the application can increase the nutrient value of soil (Berti et al. 2006; Seleiman et al. 2010; Berton et al. 1989).

Figure – 2: Variation of pH concentration

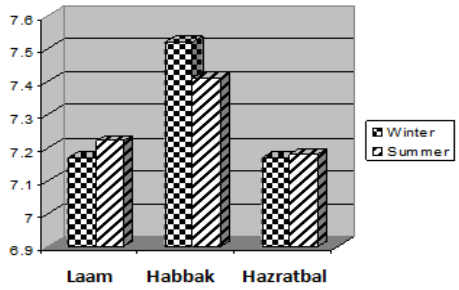


Figure – 3: Variation of OC content (%)

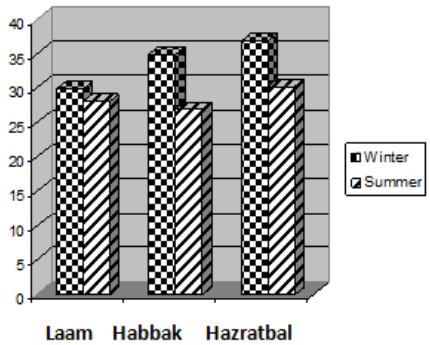


Figure – 4: Variation of E.C. (ms/cm)

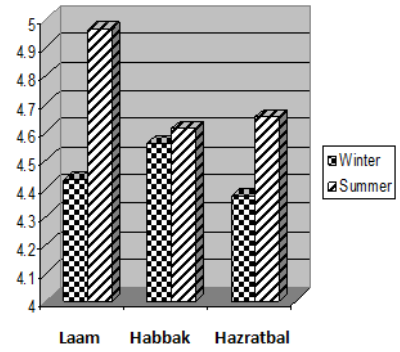


Figure – 5: Variation of N content (mg/kg)

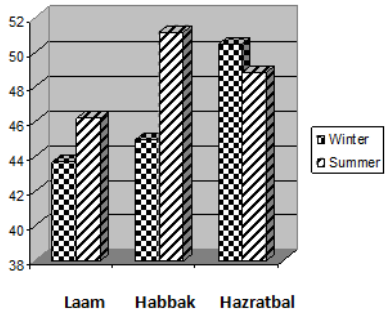


Figure – 6: Variation of P content (mg/kg)

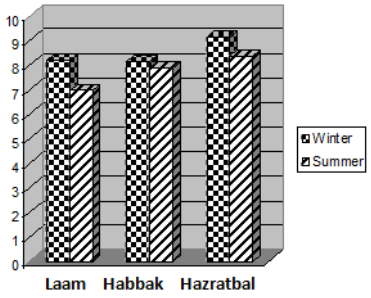


Figure – 7: Variation of Zn content (mg/kg)

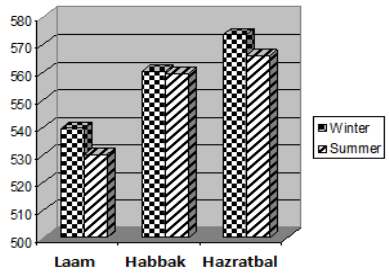


Figure – 8: Variation of Cu content (mg/kg)

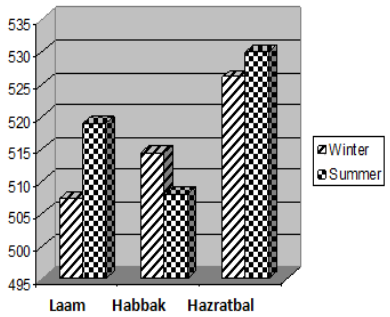


Figure – 9: Variation of Mn content (mg/kg)

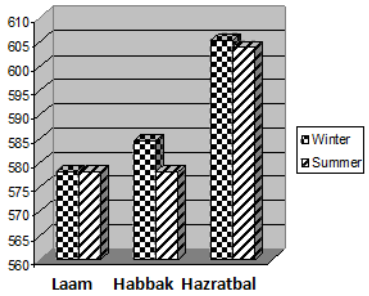
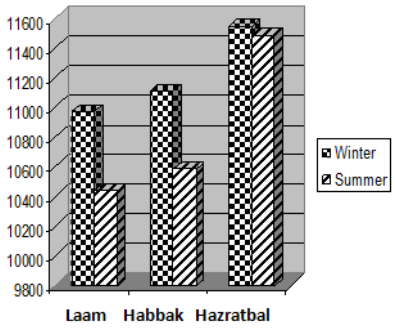


Figure – 10: Variation of Fe content (mg/kg)



The amount of DTPA extractable available micro nutrients was present in sufficient amounts for any practical importance. The available zinc ranges from 530.08 mg/kg to 573.83 mg/kg. The available manganese value ranges from 578.16 mg/kg to 605.33 mg/kg. Both the available zinc and manganese were found in significant percentage to be used as a fertilizer and improve crop productivity (Oudeh 2002; Syman et al. 1998).

The present investigation also reveals that the available copper ranged from 507.33 mg/kg to 530.10 mg/kg. The available iron values varied from 10438.66 mg/kg to 11546.80 mg/kg. Available copper and iron were present in sufficient percentage may be use for improving soil nutrient value and productivity of crops (Zoubi et al. 2008; Walter et al. 2003).

The results showed increase in percentage of micro and macro nutrients in the sewage sludge during peak winter due to harsh climate prevailing in the valley which decreases the efficiency of secondary treatment of moving bed bioreactor sewage treatment plants. Moreover the sewage treatment plant of Laam shows increase in efficiency due to the diluted and low inflow of sewage coming to the sewage treatment plant. A comparative study of efficiency between three experimental treatment plants has been depicted in Figure 2 to 10. The Hazaratbal sewage treatment plant shows higher micro and macro nutrients due to the large catchments area which leads to the concentrated sewage inflow to the sewage treatment plant. Results showed that the organic carbon was found in significant percentage to be used for improving the soil

physical characteristics. The data also shows alkaline nature of sludge which would be rather used for the reclamation of acidic soils. Among the DTPA extractable micro nutrients, Fe was present in dominant concentration and Zn, Cu and Mn were present in sufficient quantity.

References

Ahmad B., Babsh K., Hassam S. (2006) Effect of Sewage water on spinach yield. *Int. J. Agric. Biol.* 8, 423-425.

Akram M., Akram Qazi M., Ahmad N. (2006) Integrated nutrient management for wheat by municipal sewage sluge in rice-wheat and cotton cropping system. *Polish, J. of Environ. Stud.* 16, 495-503.

Alzoubi M.M, Arslan A., Abdelgawad G., Pejon N., Tabaa N., Jouzdon O. (2008) The effects of sewage sludge on productivity of a crop rotation of wheat, maize and vetch and heavy metal accumulation in soil and plant in alpeppo governorate. *American– Eurasian J. Agric & Environ. Sci.* 3(4), 618-625.

Berti D.L., Doberman A., Sander D.H., Cassman K.G. (2006) Biosolids and nitrogen source for irrigated maize and rainfed sorghum. *Soil Sci. Soc. Am.* J. 66, 531-443.

Bowen P.T., Jacken M. K., Corbitt R. A., Concc N. 1992 Sludge treatment, Utilization and disposal. *Water Environ. Res.* 64, 378-386.

Casado-Vela J., Seues S., Dlazerepo C., Navarso-Pedreno J., Matrix Benyto J., Gomez I., (2007) Effects of complied sewage sludge application to soil on sweet pepper crop growth under two exploitation regimes. *Waste Management.* 27, 1509-1518.

Chaney R.L. (1983) Potential effects of waste constituents on the food chain in land treatment of Hazardous waste. ed., J.F. Parr. Noyes Data corp. pp. 50-76.

Hormann C.M., Turbmen O., Turam M., Sensory S., Cirka M. (1995) Effects of sludge on seed emergence, development and mineral contents of pepper seedlings. *Asian J. Plant Sci.* 4, 229-304.

Jacob L.W. (1981) Agricultural application of sewage sludge. in sludge and its ultimate disposal. ed. J.A. Borchardt, W.J., Redman G.E., Jones and R.T. Sprague. Ann Arbor Science publishers. *Ann Arbor Michigan* pp. 109-126.

Jawakar S., Paglial M. (1991) Effects of sludge and compost on soil porosity and aggregation. *J. Environ. Qual.* 10, 556-561.

Matthews P.J. (1984) Control of metal application rates from sewage sludge utilization in agriculture. *CRC Crit. Rev. Environ. Control.* 4, 199-250.

Oudh G., Businelli D., Giusguiani P. (2002) Trace metal uptake and Distribution in corn plants grown on 6 year urban waste compost amended soil. *Agr. Ecosyst. Environ.* 58, 199-206.

Seleiman M., Santanen A., Manninen P., Stoddard F., Makel P. (2001) Sewage sludge as nutrient source for the bio energy and food crops. *Department of Applied Biology, University of Helsinik.*

Syman N.V., NamJiith S. (1998) Sewage sludge in Hawaii : Chemical Composition and rreaction with soil and plants. *Water Air Soil Poll.* 72, 265-283.

Tamrabet L., Bouzerzour H., Kribba M., Mokhiouf M. (2009) The effect of sewage sludge application on durum wheat. *International Journal of Agricultural and Biology.* 11(6), 741-745.